convinced that the blue coloring of the sky lies between two successive tones of the scale. Some practice and willingness are necessary especially when—as often happens—there are present in the sky green, red, or black tones in addition to white and blue. The observer soon becomes accustomed to focus the sense of sight on the blue coloring and eventually to pay no attention to the secondary tones. Only at great heights, either in aircraft or on a high mountain, is the blue of the sky so mixed with black that there are noticeable differences relative to the color scale made up of blue and white alone. Here it is necessary that the estimation of the blueness be made always by the same observer or that several observers practice one after another. If the observer holds the blue scale in the shade and looks quickly from the color scale to the darkest part of the sky and then back, then on an average he will estimate two or three shades lower, a result of the fact that the color tones of the scale are dependent on the amount of illumination.

It is sufficient to carry out such observations two or three times daily at determined hours, and of course most practicably at the international hours, 7 or 8 a. m., noon to 2 p. m., and about 7 p. m. (at least in the summer). In winter a 10-hour period is to be recommended. In the statistical enumeration there is noted how often in a given month the different scale values were found, that is in percentage of the total number of observations. Since the full number of observations, two or three, will not be available on all days a single value for each day determined by averaging must be considered in monthly means or the calculation must be made for each observation hour.

Results of observation.—Unfortunately, data on the coloring of the sky for a long period of years are not available. On the basis of my Argentine series (1923) I was first able to state that the blue coloring of the sky (B) stands in logarithmic relation to the turbidity factor (T). There exists the following relation, $B = 12.0 - 14.5 \log. T$. On our Lapland expedition (1927) I ascertained that polar air has a deeper (blue) coloring than sea or tropical air. Before approaching cloudiness there occurs a marked decrease in blue coloring, thus a lighting up of the sky, caused by hydroscopic enlargement in the aerosole (dispersed particles suspended in the atmospheric gases).

Never could there be recognized a daily period in blue coloring, although it must be assumed as certain that the darkest point of the sky is darker, taken absolutely, when the sun is low than when it is high. But since the blue scale is evidently made lighter in equal measure through illumination by the sun, this effect is canceled, so that with this blue scale one arrives at an estimate that is independent of the sun. F. Loewe found in his aircraft flights an increase in blue coloring from 6.4 at the ground to 11.8 at the elevation of 6km. (0–14 scale).

The *purpose* of this estimation of the blue coloring of the sky is a rough approximation of the purity of the air; that is, of the number and size of the aerosole. Heretofore there have been in use in widely different parts of the earth over 100 scales of blue. It is to be desired that results of observations be made known from time to time; with careful observance of the above directions these will serve as comparable data.

Sets of the blue scale.—The Meteorologisch-Geophysikalische Institute, Frankfort on the Main, receives the scales in rather large orders from the laboratory of Professor Ostwald, and forwards them in return for the manufacturing cost of 3.5 marks plus postage.—*Translated by W. W. Reed.*

BLUE-SKY MEASUREMENTS AT WASHINGTON, D. C.

By IRVING F. HAND

[Weather Bureau, Washington, July 31, 1928]

The method of obtaining and utilizing blue-sky measurements has been described in the above article by F. Linke. Since the publication of my brief note on "Blue-sky measurements" in the MONTHLY WEATHER REVIEW for May, 1927, no skies of a deeper blue than 8, or of a whiter color than 4 have been observed. A summary of all observations to date is given in Table 1.

Visibility and polarization show the greatest correlation with sky color. However, due to topography and other reasons, such as low haze, fog in the valley, poor illumination owing to position of the sun, cloud arrangement, etc., it often happens that the visibility is relatively poor with a deep-blue sky; an effect which is masked in the table by the large number of observations. Polarization is less affected by such causes, however, as these measurements are generally made in the same sector of the sky as the color measurements, or to be more exact, at a point 90° from the sun and in his vertical, with a solar altitude of 30° (air mass = 2.0). It is thus evident that when observing the sky for color at a comparatively high angle less interference due to atmospheric pollution or to optical phenomena will occur than when measuring visiblity through a layer of the lower air 50 or more miles in extent.

TABLE 1.—*Relation between sky color and other meteorological elements*

Color scale	Visibility	Skylight polarization	Solar radiation at normal incidence. Air mass = 2.0	Number of dust particles per cubic centimeter	Vapor pressure	Wind	Average number of days since precipitation occurred
	Miles	*Per cent*	*Gr. cal./cm.²*		*Inch*	*M. p. h.*	
4	14.9	52.6	1.05	911	.702	4.3	2.4
5	23.3	56.5	1.12	702	.697	5.4	1.8
6	37.8	59.0	1.18	521	.520	8.4	2.3
7	44.4	61.1	1.25	811	.382	10.7	1.3
8	50.0	63.0	1.37	160	.160	30.0	[1] 0.0

[1] Immediately following rain.

The irregular relationship between sky color and the number of dust particles in the atmosphere is due to the location of the observatory in a suburb of Washington, as an easterly component of wind will give dust-count values of city conditions, while a westerly component will give country values. It was found that by eliminating a small number of observations taken with a deep-blue sky in which the wind was from the east and the number of dust particles several hundred per cent over normal, the relationship between sky color and number of dust particles became quite close.

Studies of the dust content of the atmosphere [1] have shown that there is a decided correlation between atmospheric dust content and wind velocity, as the higher velocities tend to carry away impurities. Thus the apparent close relation between sky color and wind velocities is in reality but a secondary effect.

As would be expected, the amount of water vapor in the atmosphere has a strong influence on the color of the sky. Generally speaking, it has been found that the clearest or the bluest skies occur shortly after precipitation.

The correlation between sky color and radiation intensity is so close that it is nearly always possible to estimate with a surprisingly high degree of accuracy the value of the latter element by merely looking at the sky.

[1] Kimball, Herbert H. & Hand, Irving F. Investigations of the dust content of the atmosphere. Mo. Wea. Rev., Mar. 1924, 52:133-141.
Kimball, Herbert H. & Hand, Irving F. Investigation of the dust content of the atmosphere. Mo. Wea. Rev., June, 1925, 53:243-246.

HEAVY SNOWFALL OF APRIL 27 AND 28, 1928, IN UPPER OHIO VALLEY

By W. C. Devereaux

[Weather Bureau, Cincinnati, Ohio]

One of the greatest snowfalls of record, not only for April, but for all months, occurred on April 27 and 28, 1928, in extreme eastern Kentucky, the mountains of North Carolina, portions of West Virginia, and southwestern Pennsylvania. This snowfall was unusual as it occurred in the extreme northwestern section of a general low area moving northeastward over the South Atlantic States, when the season was far advanced, and over a region much of which is comparatively free of heavy snowfalls.

The area of heavy snowfall extended from Asheville, N. C., to west-central Pennsylvania, a distance of 400

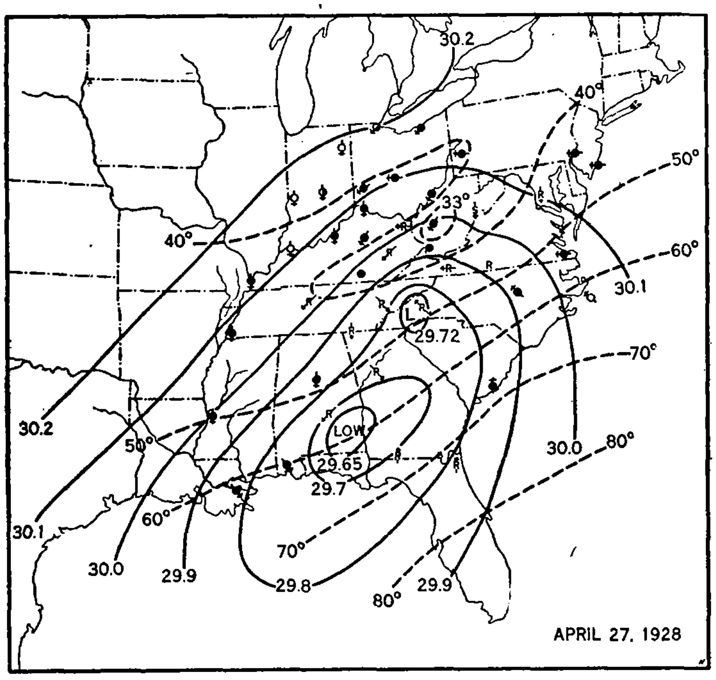

Fig. 1.—Weather map 8 a. m., 1928. For detailed data see Figure 2

miles. Within this region the surface of the ground varies mostly from 1,000 to 3,000 feet above sea level. With the exception of Mount Mitchell in North Carolina at an elevation of over 6,700 feet, the highest hills or so-called mountains do not exceed 3,000 feet in elevation, with a few exceptions in West Virginia. Although the differences in elevation between the valleys and the hilltops do not exceed a few hundred feet, the difference was sufficient to give snow on the hills and mostly rain in the valleys.

There was but little indication of heavy snow for West Virginia on the Daily Weather Map for 8 a. m. April 27. (See fig. 1.) At that time the general storm area was central over southern Alabama and moving northeastward. Snow was falling at the time of observation at Elkins, W. Va., and the wind was southeast at Asheville, N. C., which might be considered irregular, but otherwise nothing unusual was shown on the map.

Another map on a much larger scale, and for the Ohio Valley only, was prepared at the same time at the Cincinnati station. (Fig. 2.) Weather reports from river stations, in addition to the regular reports, were used in the preparation of this map. While the reports from the substations do not show atmospheric pressure the other weather elements can be used to advantage.

This special map shows a decided northward bulge of the barometric lines over the upper Ohio Valley, with a secondary depression fairly well defined over extreme western North Carolina, the center being near to and just west of Asheville at 8 a. m.

The special map shows that the isobars are crowded comparatively close together from eastern Tennessee to West Virginia, and heavy rain and snow started early that day in eastern Kentucky and all of West Virginia. Up to the time of observation more than an inch of precipitation had occurred along the Kentucky-Virginia line and at one station in West Virginia. This rapid development of an extensive area of precipitation was a good indication of the strength of the storm.

A careful study of all the data shows the development and growth of this slight secondary depression over the Tennessee-North Carolina line. The pressure began to fall at all the surrounding stations about 2 a. m. April 27, and rain started about the same time in extreme eastern Tennessee and extreme western North Carolina. The wind at Asheville was south from 2 a. m. to 4 a. m., southeast from 4 a. m. to 9 a. m. and north or northwest after 9 a. m. At Wytheville, Va., the wind was northeast from 2 a. m. to 4 a. m., east from 4 a. m. to 1 p. m., and then shifted to north and northwest.

Another special map for 12 noon, prepared later from mail reports, is reproduced as Figure 3. This map shows the northward bulge in the pressure lines,[1] and that the secondary depression was moving slowly northeastward and filling up. The wind shift and pressure changes indicate that the secondary depression passed Asheville about 9 a. m., Wytheville, Va., about 1 p. m., and merged with the general storm area during the afternoon of April 27. More important than pressure or wind elements on the noon map are the lines that show the time of beginning of precipitation. This is an element that should be shown on forecast maps. The northern bulge in the pressure lines disappeared during the afternoon of April 27 over the extreme eastern edge of the Ohio Valley. The wind at Pittsburgh, Pa., shifted from northeast to

[1] See figs. 1 and 2 for pressure lines.—Ed.